



REVIEW ARTICLES

Trends in Acute Myocardial Infarction and Coronary Heart Disease Death in the United States

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Coronary heart disease accounted for 489,171 deaths in 1990. Age-adjusted death rates decreased faster between 1976 and 1990 for white men than for white women or blacks. Out of hospital death rates for coronary heart disease decreased in the 1980s. Hospital fatality rates for acute myocardial infarction continued a long-term decrease through 1990. Trends in risk factors and

invasive procedures support the conclusion that risk factor reduction has resulted in reduced incidence of acute myocardial infarction and sudden coronary death and that improvements in medical care have resulted in a continued decrease in acute myocardial infarction fatalities and overall coronary deaths.

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During the past decade, many important techniques for the treatment and prevention of coronary heart disease were developed and applied with increasing frequency. It is useful to examine the recent trends in risk factors and use of invasive procedures for coronary artery disease to assess the impact of these developments on coronary heart disease, the leading cause of death in the United States and to help set or modify priorities for the remainder of the 1990s and beyond (1,2). Using data from the Centers for Disease Control and Prevention's National Center for Health Statistics and from selected published studies, the present report provides a synthesis of current information on U.S. national trends in coronary heart disease mortality, acute myocardial infarction occurrence, coronary risk factor levels and invasive coronary procedures.

Coronary Heart Disease Trends

Coronary heart disease mortality. In 1990 there were 489,171 deaths attributed to coronary heart disease (International Classification of Diseases, Ninth Revision [ICD-9], codes 410 to 414) in the United States: 236,574 women and 252,597 men (3,4). This is a decrease from the reported 509,592 deaths in 1988 due to coronary heart disease, in which year coronary heart disease was mentioned as a secondary cause in another 104,469 deaths. Age-adjusted death rates per 100,000 by gender and race in 1990 were as follows: white men 145.3, black men 147.1, white women

68.6, black women 88.8. Age-adjusted death rates decreased for each group between 1980 and 1990 (Fig. 1).

A report that U.S. coronary heart disease death rates decreased faster for white men than white women and blacks between 1976 and 1985 (1,2,5) emphasized the need for continuing surveillance studies of coronary heart disease in women as well as men. An analysis of more recent data shows that this disparity has continued through 1990 (Fig. 1). The average annual decrease for 1980 to 1988 by race and gender in adults aged ≥ 35 years was 5.7% for white men, 3.1% for black men, 2.9% for white women and 2.2% for black women (5). This finding is consistent with the observation in Worcester, Massachusetts that the incidence of acute myocardial infarction decreased less in women than in men from 1975 to 1988, especially in those aged 25 to 54 and 65 to 74 years (2). The relative roles of acute myocardial infarction incidence and fatality as well as mortality from chronic coronary heart disease in contributing to these gender and race differences should also be investigated in surveillance studies in other parts of the country (2). Decreases in coronary heart disease death rates occurred in all U.S. regions and states. However, there was considerable geographic variation in the rate of decrease, which was highest in the Northeast and lowest in the South (6).

Decreases in out of hospital coronary heart disease deaths were observed for the 40 states with data on place of death available between 1980 and 1985 and for Worcester residents between 1975 and 1988 (2,7). Considerable geographic variation in out of hospital coronary heart disease deaths has been recently reported (8). Extrapolation of data from the 40 states to the entire United States showed that in 1985 an estimated 301,000 deaths due to coronary heart disease (56% of the total) occurred out of hospital or in emergency rooms among adults aged ≥ 25 years (8). Because a reduction in this death rate by even a small fraction would mean many lives saved, it is important that both community

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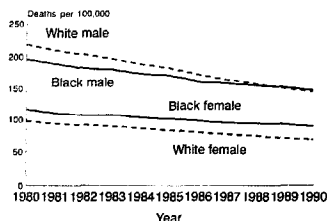
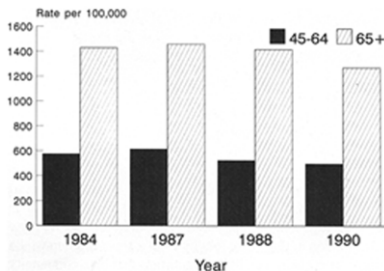


Figure 1. Age-adjusted death rates per 100,000 for ischemic heart disease by gender and race: United States.

studies and coronary heart disease prevention efforts continue.

Hospitalization and fatality due to acute myocardial infarction. In 1990 an estimated 675,000 patients were discharged from U.S. hospitals with a first-listed diagnosis of acute myocardial infarction (401,000 aged ≥ 65 years; 413,000 men, 261,000 women) (9). The rates per 100,000 in 1990 were 497 for age 45 to 64 years and 1,270 for age ≥ 65 years (34.2 men, 20.3 women). The respective rates in 1988 were 524 and 1,416; in 1987, 615 and 1,458; and in 1984, 575 and 1,429 (Fig. 2). As previously noted, national discharge rates for patients with acute myocardial infarction, both for first and all diagnoses, had not decreased consistently since 1970 in contrast to coronary heart disease mortality rates (10). However, both numbers and rates of patients with acute myocardial infarction discharged from hospital decreased between 1988 and 1990, suggesting a possible decrease in the occurrence of discharged combined initial and recurrent acute myocardial infarction. Comparisons of data from 1988 to 1990 with earlier years must be done with caution because of the redesign of the National Hospital Discharge Survey

Figure 2. Hospital discharge rates per 100,000 for first-listed diagnoses of acute myocardial infarction by age: United States.



(NHDS) in 1988, which broadened its coverage slightly. The possible effects of the introduction of prospective payment based on diagnosis-related groups (DRGs) in 1983 to 1986, as well as other problems with regard to surveillance of community and national trends for acute myocardial infarction, have been discussed elsewhere (2,10). The methodologic problems with regard to NHDS trend data, together with a probable increase in rates of admission for recurrent acute myocardial infarction because of increasing numbers of survivors may explain why U.S. hospital discharge rates of patients with acute myocardial infarction failed to decrease before 1987 despite other studies that report a decreasing acute myocardial infarction incidence throughout this period (2). If the downward trend in NHDS rates after 1988 continues, it would be an important confirmation at the national level that the incidence of acute myocardial infarction is probably decreasing, as reported in several communities (2).

Acute myocardial infarction fatality rates continued a long-term decline. In 1984, the U.S. acute myocardial infarction fatality rate was 7.7% for age < 65 years and 22.4% for age > 65 years. In 1987 the rates were 5.9% and 19.8%, respectively; in 1990 they were 5.0% and 17.6%, respectively (9). Downward trends in fatality rates in hospital before 1984 have been described elsewhere (10). The U.S. fatality rates decreased for both men and women (10). Previous reports of national data have indicated higher hospital acute myocardial infarction fatality rates in women than in men, especially those < 70 years old (10,11). For hospital discharge of patients with any diagnosis of acute myocardial infarction in the United States during 1988 to 1990, the in-hospital acute myocardial infarction fatality rate was 10.1% in women and 8.4% in men aged 55 to 64 years and 14.9% in women and 12.9% in men aged 65 to 74 years. Community surveillance studies will continue to be important for the elucidating reasons for these and other trends and patterns observed in the national data (2,10,12,13).

Risk Factor and Medical Care Trends

Risk reduction versus medical care. Still under debate is the extent to which the reduction in coronary heart disease mortality over the past two decades was due to a reduction in the incidence of coronary heart disease because of reduction of risk factors or to a reduction in fatalities and long-term mortality after acute myocardial infarction or onset of angina pectoris because of improved medical care, or to both (2,14). Recent data for the United States supports the conclusion that risk factor reduction has resulted in a reduced incidence of acute myocardial infarction and sudden coronary death and that improvements in medical care have resulted in a continued decrease in acute myocardial infarction fatalities and overall coronary heart disease mortality.

Smoking. During the 1980s, the prevalence of cigarette smoking in the United States continued to decrease. In 1987, 28.8% of adults (31.2% of men, 26.5% of women) aged ≥ 18 years smoked cigarettes. The age-adjusted percent of adults

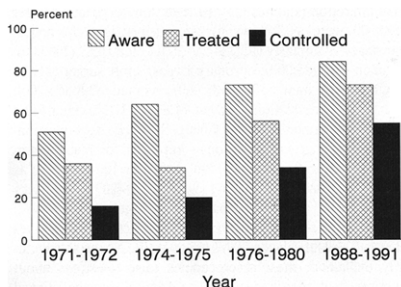


Figure 3. Hypertension (blood pressure $\geq 160/95$ mm Hg on one occasion or current antihypertensive agent therapy) awareness, treatment and control rates in the United States. Source: National Health and Nutrition Examination Survey (NHANES) I (1971 to 1975), NHANES II (1976 to 1980), NHANES III (Phase I, 1988 to 1991) (17).

aged ≥ 18 years who smoked cigarettes was higher in black than white men but was similar in black and white women. The percent decreased between 1979 and 1987 in each group (3). The long-term rate of decrease between 1965 and 1987 was $-0.5\%/year$ (15). Nonetheless, more recent data indicate that in 1990, 45.8 million (25.5%) of the U.S. civilian, noninstitutionalized population aged >18 years (28.4% of men, 22.8% of women) were current smokers (15). Of 89.9 million persons who had ever smoked cigarettes, 49.1% had ceased smoking. Although, it is encouraging that the age-adjusted smoking prevalence rate decreased at an accelerated rate of 1.1%/year between 1987 and 1990, there was no decrease in smoking prevalence between 1990 and 1991 (25.7%). This was due to an increase in smoking among blacks and white women (16) that may have occurred because of increased availability of discount cigarettes and increased cigarette advertising.

Hypertension. The prevalence of increased blood pressure and the awareness, treatment and control of hypertension in the United States have only recently been documented for the 1980s. Blood pressure of at least 160 mm Hg systolic and 95 mm Hg diastolic occurred in 17.6% of adults aged 20 to 74 years during 1976 to 1980 and increased with age from 4.9% at age 20 to 24 years to 34.5% at age 65 to 74 years (3). The age-adjusted percent declined between 1971 and 1974 and 1976 and 1980 in blacks and white women and had changed little during the previous decade (1,3). The Third National Health and Nutrition Examination Survey (NHANES III), still underway, has recently provided preliminary data on increased blood pressure, allowing assessment of trends in the 1980s. For assessment of changes between 1976 and 1991, hypertension was defined as blood pressure $\geq 140/90$ mm Hg on one occasion or current antihypertensive agent therapy (17). Preliminary data from the

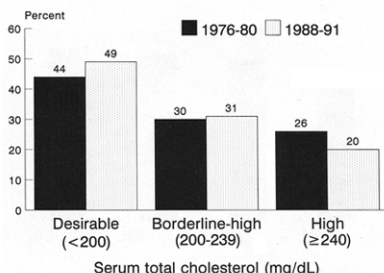


Figure 4. Age-adjusted total serum cholesterol levels in the U.S. population aged 20 to 74 years, 1976 to 1991. Source: National Health and Nutrition Examination Survey (NHANES) II (1976 to 1980), NHANES III (1988 to 1991). Reproduced with permission from Sempos et al. (19).

1st 3 years of this survey (1988 to 1991) indicated that the prevalence of hypertension (26%) decreased, and the percent of hypertensive patients aware of their condition (65%), the percent receiving medication (49%) and the control rate (43%) increased substantially compared with that during 1976 to 1980 (30%, 54%, 33%, 33%, respectively) (17). Longer term trends showed steady improvements since 1971 (Fig. 3). Controlled patients were defined as those currently taking antihypertensive medication and who have blood pressure below the stated criterion on one occasion.

Serum cholesterol. Data on U.S. serum cholesterol levels for 1988 to 1991 have also recently been published (18,19). Despite a slight decrease after 1971 to 1974, more than one-quarter of each gender and race group (26% overall) had total serum cholesterol values ≥ 240 mg/dl in 1976 to 1980 (3,19). By 1988 to 1991, the prevalence of high total serum cholesterol further decreased to 20% overall (Fig. 4) (19). The percent with desirable total serum cholesterol levels (<200 mg/dl) increased from 44% to 49%. Nevertheless, $\sim 29\%$ of U.S. adults currently require dietary intervention for high blood cholesterol levels (19,20).

Mean age-adjusted total serum cholesterol levels decreased from 217 to 211 to 205 mg/dl in men and from 222 to 214 to 205 mg/dl in women in 1960 to 1962, 1976 to 1980 and 1988 to 1991, respectively (18). Decreases in mean total serum cholesterol levels were primarily due to decreases in low density lipoprotein cholesterol levels (18). Data from clinical trials and prospective observational studies indicate that decreases in serum cholesterol levels between 1976 and 1980 and 1988 and 1991 might account for roughly an 8% to 17% decrease in coronary heart disease incidence (18).

Medical care. Important trends in medical care for acute myocardial infarction and angina pectoris in the U.S. have been reported (1,3). Preliminary estimates from NHANES

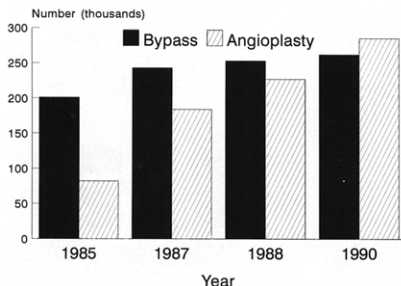


Figure 5. Number of coronary artery bypass graft (ICD-9-CM 36.1) and coronary angioplasty procedures (removal of coronary obstruction, ICD-9-CM 36.0): United States.

III (1988 to 1991) indicate ~4 million adults in the United States with established coronary heart disease (19). Data from the National Hospital Discharge Survey for 1980, 1985 and 1988 to 1990 show a marked increase in the rate of cardiac catheterization and coronary bypass graft procedures at ages 45 to 64 and ≥ 65 years (3,9). An interesting phenomenon was that before 1985, men aged 45 to 64 years underwent both procedures at equal or higher rates than men aged ≥ 65 years. However, in 1988 to 1990, rates for both procedures were higher in men at age ≥ 65 years, indicating a greater propensity of physicians to diagnose and perform bypass surgery of coronary obstructions in the elderly compared with younger patients. The estimated number of coronary bypass graft procedures increased in 1990 to 262,000, and the number of coronary angioplasty procedures increased from only ~2,000 in 1979 to 285,000 in 1990, continuing long-term trends (Fig. 5). Since 1984 the use of the internal mammary artery in combination with saphenous vein bypass procedures increased (9,21). The ICD-9 Clinical Modification (CM) rubric (36.0) used here for angioplasty trends includes a small number (<10%) of other procedures to remove coronary obstruction. More specific coding procedures introduced in the late 1980s (ICD-9-CM 36.01, 36.02, 36.05) indicate that an estimated 260,000 coronary angioplasty procedures were performed in 1990, equalling the number of bypass procedures (9). National data on trends in drug therapy after acute myocardial infarction to improve survival are limited but suggest major increases in the use of thrombolytic therapy, beta-adrenergic blocking agents and aspirin (22,23). In one Massachusetts community, the use of a number of noninvasive and invasive procedures after acute myocardial infarction increased between 1975 and 1988 (24).

As in previous reports of age-specific or age-adjusted rates, recent U.S. rates for cardiac procedures were lower in women than in men, which is disproportionate to differences in coronary disease prevalence, mortality, or acute myocar-

dial infarction fatalities (25). In 1990, for example, rates per 100,000 were as follows for specified ICD-9-CM codes: coronary angioplasty (ICD-9-CM 36.0), men 165.7 (200,000), women 66.2 (85,000); coronary bypass graft surgery (ICD-9-CM 36.1), men 155.6 (188,000), women 57.8 (74,000); cardiac catheterization (ICD-9-CM 37.21-37.23), men 512.4 (620,000), women 292.6 (376,000). Similarly disproportionately low rates were previously reported for blacks compared with whites (25). In 1990, rates per 100,000 were as follows: coronary angioplasty, whites 99.9 (209,000), blacks 17.6 (5,000); coronary bypass graft surgery, whites 98.5 (206,000), blacks 19.6 (6,000); cardiac catheterization, whites 350.1 (733,000), blacks 209.7 (65,000) (9). Never satisfactorily explained, these discrepancies raise questions about differences in access to surgical care and physicians' clinical decision making in white women and blacks compared with white men (23-28).

Priorities for the Future

The national health objectives have been published for the year 2000 (29). These objectives, together with thoughtful examination of data from the past decade, will help establish priorities for research and efforts in health promotion and disease prevention for the remainder of the 1990s. Some objectives particularly relevant to the present discussion include the following (29):

Reduce coronary heart disease deaths to no more than 100 per 100,000 people. (Age-adjusted baseline: 135 per 100,000 in 1987.) Reduce cigarette smoking to a prevalence of no more than 15 percent among people aged 20 and older. (Baseline 29 percent in 1987. . .) Increase to at least 50 percent the proportion of people with high blood pressure whose blood pressure is under control. (Baseline: 11 percent controlled among people aged 18 through 74 in 1976-80; an estimated 24 percent for people aged 18 and older in 1982-84.) Reduce the mean serum cholesterol among adults to no more than 200 mg/dL. (Baseline: 213 mg/dL among people 20 through 74 in 1976-80.) Reduce the prevalence of blood cholesterol levels of 240 mg/dL or greater to no more than 20 percent among adults. (Baseline: 27 percent for people aged 20 through 74 in 1976-80. . .)

In addition to continuing research in the management of myocardial infarction and angina in women and men, many aspects of coronary prevention require investigation. For example, the less than expected rate reduction in coronary heart disease mortality with antihypertensive therapy calls for new clinical trials comparing the efficacy of various classes of drugs, including the newer alpha-blockers and calcium channel blocking agents in women and men, blacks and whites (29). The need for special smoking cessation efforts for blacks has also been recognized (30).

Recent estimated costs of cardiovascular disease in the United States were \$135 billion/year (29,31). Every 5 years, \$187 billion (18% of medical expenditures) were paid for the

excess medical expenditures of smokers (32). For 1988, the Centers for Disease Control and Prevention estimated that only 3% of total health expenditures was spent on prevention (31). Increased expenditures for prevention more than the current 3% of health expenditures and more effective prevention programs are needed to achieve the goals of reducing coronary heart disease incidence and mortality in the United States. Measures are needed to remove financial and nonfinancial barriers to access to cardiovascular care (33). Continued vigorous efforts at primary and secondary prevention of coronary heart disease are clearly needed. Physicians may need to devote special attention to female or black patients to ensure that they receive strong messages with regard to smoking and other risk factors and that they use appropriate therapeutic interventions. National statistics and detailed surveillance studies of communities and special populations continue to be essential in planning and monitoring the impact of such efforts.

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